The Madras Agricultural Journal.

(ORGAN OF THE M. A. S. UNION)

Vol. XXVII.] DECEMBER 1939 [No. 12.

EDITORIAL

Agricultural Research and the War. In our last issue we made a plea that the war should not in any way hamper the activities of agricultural research organisations in this country. We urged that rather than curtailing research activities, they should be strengthened in such a manner as to augment the economic prosperity of the country and the Empire. It is heartening to agricultural research workers in this country and to the millions who stand to benefit by their activities that two of India's foremost administrators who are best qualified to speak on the subject, have expressed themselves convincingly on the importance of agricultural research in wartime. Addressing the advisory board of the Imperial Council of Agricultural Research, Mr. P. M. Khareghat, Vice Chairman and chief administrative officer of the council has expressed the view that "research designed to develop agricultural and live stock resources of the country must continue." Sir Jagadish Prasad, member of the Viceroy's Executive Council and member in charge of Education, Health and Lands, addressing the crop and soil wing of the Board of agriculture and animal husbandry, went a step further when he laid bare a fallacious belief held in certain quarters that in times of emergency research is the first item which comes up for retrenchment. Sir Jagadish deplored this attitude and quoted the example of Great Britain where the Department of Scientific and Industrial Research came into being in 1917 at a critical period during the Great war when a sum of £ 1,000,000 was made available to this purely research organisation. Later events amply justified the wisdom of this investment at a period of crisis and competent critics have expressed the view that no expenditure was laid to better use than the money spent on pure research. He declared that it is up to those who are responsible for guiding and fostering agricultural research in India to take advantage of the increased demand on commodities of which India is the prime producer "by using the opportunity for new drives towards greater efficiency in crop production, interpreting old knowledge in the light of the new crisis, and adding as quickly as may be, new knowledge to meet old difficulties." It is a matter of satisfaction to us that representatives of the Imperial Council of Agricultural Research and the Government of India share the view that instead of being an obstacle to progress, the war situation may, if rightly used, be an opportunity to accelerate scientific progress in India, a need which all well wishers of the country rightly realise.

A Preliminary Study in the Biometric Variations in the Indian Honey Bee.

By R. RATNAM, B. A.,

Agricultural Research Institute, Coimbatore.

Introduction. The existence of variations in plant or animal life is the factor that facilitates the work of the biologists towards the isolation of the more useful varieties for purposes of further improvement. Newton (1917), Ghosh (1936) and Ramachandran (1937) have recorded about the larger honey storing capacities, their darker colour and larger size of some hill varieties of Indian bees. Even in the varieties found in the plains, the present author has observed certain colonies showing remarkably desirable characters, such as mild temper, minimum swarming propensities, larger honey gathering and stamina to resist unfavourable seasonal conditions. Ramachandran (1937) has also made mention of the different "idiosyncracies" of the various hives in an apiary. A detailed study of the biometric variations, if any, that differentiate bees possessing diverse characters has not so far been made in India.

Review of Literature. Merrill (1922) working in America found that there is a distinct correlation between tongue length of bees and their carrying capacity, that the colonies having bees with longer tongues contain heavier bees and are more populous in spring, and that if a bee is deficient either in tongue length or in weight or in carrying capacity, the disadvantage may be overcome if it possesses the two other of the above three characters to a greater degree. Alpatov (1929) has worked on the biometry of the most important European races of the honey bee based on materials collected in their respective native locations in Europe as well as materials collected in the U. S. A., where the honey bee was imported from Europe. He has classified the influence of different environmental conditions on the honey bee and has concluded that such factors as season, temperature, size of cells, age of combs, nutrition of larva, strength of colony etc.,—all these—affect the biometry of the honey bee. He has also studied in detail the geographical variations in the biometry of the honey bee and finds that the southern constitutional type of the European bee differs from the northern one. This worker further concludes that "parallel to the geographical variation in physical characteristics run the variation of biology and behaviour" such as swarming propensities, preference in collecting nectar from different plants etc. Phillips (1929) has studied the correlations between the various appendages of the honey bee and has concluded that the drones show greater variations than workers and that the size of the comb cell shows great heterogenity and this affects the size of the adult bees. Kellog and Asquith (1934) studied the variations in individual colonies with a view to isolating the more useful ones. They

found certain variations in the capacity of nectar sac and the pollen loads brought by bees but much less variations in biometric measurements. Grout (1937) provided artificial comb foundations with varying cell dimensions and concluded that the size of the brood cell is definitely a factor in determining the size of the adult worker bee. He adds (Grout, 1936) that no increased quantity of honey is proved to have been obtained by the employment of enlarged cell foundations. Nolan (1937) has given a resume of the various attempts made at breeding the honey bee taking advantage of the variations. In some respects the observations of McGregor (1938) are not in conformity with those of Alpatov (1929) since the former has found that nurse bees exert no abnormal influence on the development of worker bees as seen by their tongue and wing dimensions, and that the seasonal trends and honey flow also do not affect tongue and wing lengths.

Material and Methods. The present investigation was undertaken to study the biometric variations in the Indian honey bee, collecting material, if possible, from a number of localities, but owing to personal reasons, the author finds it inconvenient to complete fully the scope of the work, and in the present paper, the data so far collected are presented.

The data relate to four colonies of *Apis indica*, which showed some variations particularly in the strength of each colony during a period of a little over three years. Colony Nos. I and IV possessed no supers during all these years, while colony No. II had one super and colony No. III two supers. It was also noticed that colony Nos. II and IV gave almost equal quantities of honey (a three year average of 9·9 lb. and 10·2 lb. per annum for colony Nos. II and III respectively) despite the fact that the former has only one super as against two supers possessed by colony No. III.

Alpatov (1929) has concluded that the biometry of the honey bee is affected by a number of environmental factors such as temperature, season etc., and Wedmore (1932) has indicated that even the age of the field bees depends to a very large extent on the amount of work they turn out, and their weight depends on their age. The effect of all these variables has to be reduced to a minimum so as to provide almost identical environmental conditions before comparing the biometry of the bees. And for this purpose, bees were collected from the four hives within a period of six consecutive days.

For his studies in Russia, Alpatov (1929) has used about 100 bees from each colony, and a minimum of five colonies for each locality. But in U. S. A. he has taken only five bees from each of ten colonies at each locality for the reason that there is no definite racial variation in U. S. A. where queens only are introduced. It was originally the present author's intention to collect at random 100 bees from each of the four colonies—50 being nectar gatherers and 50 being pollen collectors. But it has only been possible to report on about 50 nectar gatherers taken from each hive.

Bees returning to the hive without any load on their pollen baskets were caught in separate specimen tubes and they were killed immediately in

cyanide bottles used usually in entomological investigations. To find out whether each bee has a load of nectar or water, the bees were placed on a filter paper and their abdomens gently pressed. The contents of the honey sac that is disgorged on the filter paper was allowed to dry for a few seconds. Nectar leaves a translucent spot on the filter paper, but no such spot is left in the case of water. This method of distinguishing nectar-carriers from water-carriers was reported previously by Park (1926). Only nectar gatherers have been used for the following biometric studies, eliminating water carriers.

Measurements of tongue, right forewing, and right hind leg together with the number of hooks on the second right wing were recorded. Wings and legs of the bees were immediately removed and kept mounted on slides. The heads of the bees were macerated in a 5 per cent. solution of potassium hydroxide as described by Alpatov (1929). The tongues were then dissected and kept mounted in glycerine jelly.

Diameter of comb cells.— During the course of study it was casually observed that even the cell measurements in the brood combs of the Indian bee appear to vary. Seven brood combs from one hive (Newton's pattern) were at one time available and leaving aside the few rows of cells at the top which are usually used for storing honey, measurements of the diameter of the worker brood cells that were recorded are furnished in Table I.

TABLE I. Diameter of cells in brood combs.

Unit of measurement.	Diameter per cell.	No. of cells.	Percentage of total.
	mm.		
8 cells in 31 mm	3 7/8	352	2·0
7 „ 27 mm.	3 6/7	308	1·7
6 „ 24 mm.	4	4,410	25·0
8 „ 33 mm.	4 1/8	2,136	12·1
7 „ 29 mm.	4 1/7	2,156	12·2
6 „ 25 mm.	4 1/6	2,700	15·3
5 „ 21 mm.	4 1/5	1,770	10·0
4 „ 17 mm.	4 1/4	176	1·0
7 „ 30 mm.	4 2/7	2,163	12·3
3 „ 13 mm.	4 1/3	897	5·0
8 „ 35 mm.	4 3/8	360	2·0
5 „ 22 mm.	4 2/5	225	1·3
		17,653	100·0

It is observed that the frequency distribution of the diameter of the comb cells is multimodal. Phillips (1929) and Grout (1937) have stated that this variation in the size of comb cells would affect the development of bees.

Tongue.— The tongue was measured in three parts, viz., submentum, mentum and ligula. For considerations of space, frequency distribution of the lengths of each of these parts has not been furnished. However, in Table II the mean lengths of these parts in the case of the hives under study are presented.

TABLE II. Length of tongue parts (in millimeters)

Hive Nos.	Submentum.	Mentum.	Total of submentum and mentum.	Ligula.
I	0·293	1·248	1·541	2·891
II	0·295	1·265	1·560	2·900
III	0·278	1·278	1·556	2·821
IV	0·269	1·290	1·559	2·753
Mean of all hives.	0·284	1·270	1·554	2·841

Table II indicates that the longest submentum occurs in hive Nos. I and II, and the shortest in hive IV; but the longest mentum is only in hive IV. It therefore appears reasonable to conclude that the bees from those hives having short mentum have relatively long submentum and *vice versa*. Nevertheless, the total aggregate length of the submentum and mentum display less variations and it is observed that no significant differences in the means of hives II, III and IV exist. As for ligula, hive IV has the shortest while hive II has the longest.

In Table III the frequency distribution of the total length of the proboscis is given. These frequencies show multimodal trends. Hive II appears to possess the longest tongue (about 4·5 mm.) and hive IV the shortest (about 4·3 mm.) the mean of all the hives being about 4·4 mm. The frequency trends being multimodal, the general means are not compared.

TABLE III. Total length of proboscis (in millimeters).

Hive No.	3·50 to 3·59	3·60 to 3·69	3·70 to 3·79	3·80 to 3·89	3·90 to 3·99	4·00 to 4·09	4·10 to 4·19	4·20 to 4·29	4·30 to 4·39	4·40 to 4·49	4·50 to 4·59	4·60 to 4·69	4·70 to 4·79	4·80 to 4·89	4·90 to 4·99	5·00 to 5·09	Total.	Mean.
I	...	1	1	1	1	4	5	2	2	5	11	12	1	1	2	1	50	4·435
II	...	...	1	...	6	2	1	1	4	7	4	12	9	2	...	...	49	4·463
III	1	1	2	3	2	...	1	2	9	5	10	10	4	...	...	...	50	4·379
IV	...	1	4	4	2	2	2	5	7	3	8	7	4	...	...	...	49	4·308
Total	1	3	8	8	11	8	9	10	22	20	33	41	18	3	2	1	198	4·397

Right Forewing. In Tables IV and V the length and breadth respectively of the right forewing have been furnished. There was a small accident and some of the slides were destroyed particularly of those from hive III. The length of the wing was measured in two stages, viz, proximal length and distal length, as described by Nolan (1937). The proximal length and distal length are almost equal being about 3·7 mm. From tables IV and V it will be seen that the length of wing of the Indian bee is about 7·4 mm. while its breadth is about 2·6 mm. and no significant differences in the means have been observed. According to Kellog and Asquith (1934) the average wing length of the European bee is about 9·3 mm. while the breadth is about 3·3 mm.

TABLE IV. Length of forewing (in millimeters).

Hive No.	6.91 to 7.00	7.01 to 7.10	7.11 to 7.20	7.21 to 7.30	7.31 to 7.40	7.41 to 7.50	7.51 to 7.60	7.61 to 7.70	7.71 to 7.80	Total.	Mean.	S. D.	S. E.	C. V.
I	...	...	4	6	12	10	6	2	3	43	7.415	0.1536	0.0234	2.1
II	...	1	4	11	8	9	7	3	2	45	7.395	0.1594	0.0238	2.2
III	1	2	1	8	6	7	7	2	...	34	7.376	0.1622	0.0278	2.2
IV	...	2	3	9	17	8	5	...	1	45	7.357	0.1301	0.0194	1.8
Total	1	5	12	34	43	34	25	7	6	167	7.386	0.1518	0.0117	2.0

Conclusions :—I, II, III, IV.

TABLE V. Breadth of forewing (in millimeters).

Hive No.	2.41 to 2.45	2.46 to 2.50	2.51 to 2.55	2.56 to 2.60	2.61 to 2.65	2.66 to 2.70	2.71 to 2.75	2.76 to 2.80	Total.	Mean.	S. D.	S. E.	C. V.
I	1	3	4	11	9	9	5	1	43	2.618	0.0753	0.0115	2.9
II	...	1	3	12	14	9	6	...	45	2.630	0.0580	0.0086	2.2
III	...	...	1	8	10	7	8	...	34	2.649	0.0557	0.0096	2.1
IV	...	...	1	10	14	11	8	1	45	2.678	0.0547	0.0082	2.0
Total	1	4	9	41	47	36	27	2	167	2.639	0.0629	0.0049	2.4

Conclusions :—IV, III, II, I.

Nolan (1937) has referred to the ratio between the length of veins marked by him as ***e*** and ***f*** in the third cubital cell of the right forewing, and states that this index is a hereditary factor wherein low cubital index is completely dominant over the high index. In Table VI this index in respect of the colonies under study is furnished. It will be seen that hive III has a very high index while hive II has the lowest. Although hives I and IV have equal indices the latter exhibits a coefficent of variation of 17.8 per cent as against 12.8 per cent for hive I.

TABLE VI. Third cubital index of right forewing (Ratios).

Hive No.	0.21 to 0.22	0.23 to 0.24	0.25 to 0.26	0.27 to 0.28	0.29 to 0.30	0.31 to 0.32	0.33 to 0.34	0.35 to 0.36	0.37 to 0.38	0.39 to 0.40	0.41 to 0.42	Total.	Mean.	S. D.	S. E.	C. V.
I	...	3	2	4	9	9	7	2	5	2	...	43	0.31	0.0395	0.0060	12.75
II	2	3	5	10	15	8	1	1	...	...	...	45	0.28	0.0279	0.0042	9.96
III	...	...	1	...	2	8	10	3	5	3	2	34	0.34	0.0342	0.0059	10.05
IV	...	4	10	2	9	5	3	2	2	2	6	45	0.31	0.0551	0.0082	17.76
Total	2	10	18	16	35	30	21	8	12	7	8	167	0.31	0.0454	0.0035	14.64

Conclusions :—III, I, IV, II.

No. of Hooks on the Second Wing. In Table VII the number of hooks found on the second wing of the bees is indicated. All except colony III have an average of about 17 hooks while colony III alone has 18. This difference is statistically significant.

TABLE VII. Number of Hooks on the Second Wing.

Hive No.	14	15	16	17	18	19	20	21	Total	Mean	S. D.	S. E.	C. V.
I	...	2	9	6	14	2	3	...	36	17·4	1·242	0·207	7·14
II	...	1	11	12	8	5	...	1	38	17·2	1 872	0·223	7·98
III	...	...	1	7	9	8	3	...	28	18·2	0·993	0·188	5·46
IV	1	2	7	15	15	2	2	...	44	17·3	1·060	0·160	6·13
Total	1	5	28	40	46	17	8	1	146	17·5	1·198	0·099	6·84

Conclusions :— III, I, IV, II.

Hind Leg. Separate measurements of femur, tibia and metatarsus were determined but they are not furnished in this paper. But in Table VIII the mean measurements of these parts for each hive is separately given.

TABLE VIII. Measurements of leg parts (in millimeters)

Hive Nos.	Femur.	Tibia.	Metatarsus.	Breadth of Metatarsus.
I	2·09	2·43	1·57	0·94
II	2·09	2·44	1·58	0 94
III	2·08	2·52	1·63	0·97
IV	2·10	2·41	1·55	0·94
Total	2·09	2·45	1·58	0·94

Table VIII indicates that though the length of femur of the bees in hive III is slightly less than that in hives I and II, yet the bees of hive III have relatively longer tibia and metatarsus, and as a result they possess very long legs, and also broad metatarsus. Table IX will show that hives I and II possess bees of equal leg lengths while hive IV has very short legged bees.

TABLE IX. Length of hind leg in millimeters.

Hive No.	5·71 to 5·80	5·81 to 5 90	5·91 to 6·00	6·01 to 6·10	6·11 to 6·20	6·21 to 6·30	6·31 to 6·40	6·41 to 6·50	Total.	Mean.	S. D.	S. E.	C. V.
I	2	3	9	13	10	4	3	1	45	6·08	0·1588	0·0237	2·61
II	...	6	6	10	5	13	3	...	43	6 11	0·1475	0·0225	2·41
III	...	...	4	2	8	16	8	3	41	6·21	0·1356	0·0212	2·18
IV	...	1	11	16	14	6	1	...	49	6·04	0·1009	0 0144	1·67
Total	2	10	30	41	37	39	15	4	178	6·12	0·1397	0·0105	2·28

Conclusions :—III, II, I, IV.

Discussion. The present study was undertaken primarily with a view to find out whether differences in biometry are met with in Indian bees. It has been noticed that wing measurements are almost equal in all the hives.

Hive II, the one super colony, has bees with long tongues, low cubital index, fewer hooks on the second wing, and hind leg of medium length. Hive III which is a very strong colony with two supers has bees with short tongue, high cubital index, larger number of hooks, on the second wing and very long legs. It should be remembered that both hives are almost equal in honey gathering capacities, despite the larger population of bees in hive III.

At best the present study is only of a very preliminary nature and further work on a number of hives of known behaviour would be very necessary before any definite attempt is made at correlating behaviour of bees and their biometry.

Selection and hybridization are the two important lines of work connected with the improvement of any species, and before any attempt at improving the Indian honey bee is taken on hand, a fuller knowledge of the variations that exist in the biometry and behaviour of different colonies of bees, and the correlations if any that exist between them is urgently called for. The consciousness of our farmers to the possibilities of bee-keeping as a cottage industry is now developing very fast, and many of the Provincial and State Governments in India are actively sponsoring schemes for popularising this industry. At this stage it seems very opportune indeed to consider the feasibilitiy of carrying out a more thorough investigation into the biometric variations of bees from various colonies of known behaviour situated in diverse localities. Such a study would perhaps facilitate the compilation of a key for the ready identification of bees possessing desirable characters instead of watching their performances and behaviour over a long period of time. These colonies can be multiplied with advantage and they may form the parent stock for further breeding. Whether particular biometric characters are stable even under changing environmental conditions is also a matter to be thoroughly studied if improving the honey bee by selection is to be successful at all. Queen rearing as an aid to the improvement of honey bee by selection is well recognised in all the important honey producing countries of the west. But so far as the conditions obtaining in India at present are concerned, this method of improving the Indian honey bee seems to be of little importance unless the mating of queens with drones from undesirable colonies can, to a reasonable extent, be prevented.

Summary and Conclusions.— For the first time a study in the biometric variations of the Indian honey bee is reported in the present paper. Four colonies of *Apis indica* have been chosen for study and the tongue lengths of bees, their wing measurements, number of hooks on the second wing, and the length of the hind leg have been recorded. They exhibit some variations in biometry particularly in tongue length, index of the third cubital cell of the right forewing, number of hooks on the second wing, and leg measurements. There is practically no variation in the length and breadth of the right forewing. Some variation in the diameter of comb cells of a hive are also observed.

References.

1. Alpatov, W. W. (1929). Biometrical Studies on Variation and Races of the Honey Bee (*Apis Mellifera*, L.). *Quart. Rev. Biol.* **4**: 1--58 illus.
2. Ghosh, C. C. (1936). Bee-keeping. Imperial Council of Agricultural Research India. Misc. Bull. 6. Third Revised Edition.
3. Grout, R. A. (1936) Influence of Brood cell upon the size of the Worker Bee. *Amer. Bee. J.* **76**: 178—179.
4. — (1937). Influence of size of Brood cell upon the size and the variability of the honey bee. *J. Econ. Ent.* **30**: 345—354.
5. Kellog C. R. and Asquith, D. (1934). Preliminary Studies in the Physical Characteristics of some Massachusetts Honey bees. *J. Econ. Ent.* **27**: 641--647.
6. McGregor, S. F. (1938). Environmental Factors and Size Variations in Honey bee Appendages. *J. Econ. Ent.* **31**: 570—573.
7. Merrill, J. H. (1922). The Correlation between some physical characters of the bee and its honey storing abilities *J. Econ. Ent.* **15**: 125—129.
8. Newton, L. V (1917). The Domestication of the Indian Honey Bee. *Agric. J India.* **12**: 44—57.
9. Nolan W. J. (1937). Bee Breeding. *Yearb. U. S. Dept. Agri.* 1937.
10. Park, O. W (1926). Water carriers versus nectar carriers. *J. Econ. Ent.* **19**: 656—664.
11. Parker, R. L. (1926). The collection and utilization of pollen by the honey bee. *Cornell. University Agric. Expt. Station. Memoir 98.* 1—55.
12. Phillips, E. F. (1929). Variation and correlation in the appendages of the honey bee. *Cornell University Agric. Expt. Station Memoir 121.*
13. Ramachandran, S. (1937). Bee-keeping in South India. *Bull 37 of the Dept. Agri. Madras.* Revised Second Edition. Government Press, Madras.
14. Wedmore (1932). Manual of Bee-keeping. Edward Arnold & Co., London.

A Note on Sugarcane Cultivation in the South Canara District.

BY K. TEJAPPA SHETTY, B. Sc., Ag.,

Agricultural Demonstrator, Coondapoor.

Introduction. There is an area of about 5000 acres under the sugarcane crop in the four coastal taluks of Coondapoor, Udipi, Mangalore and Kasargod in the South Canara District. This area was under one or two local varieties called "Dasa Kabbu" and Bidru "Kabbu". Red mauritius was introduced two decades ago, and now this variety has almost replaced the old local varieties.

The trial of some of the Co-varieties is in progress in the Kallianpur sugar factory area. The performances of a few of the thick cane varieties like Co. 419, 413, 421 and 408 are really good and there is already an area of about 150 acres under these Co-varieties in the two Taluks of Mangalore and Udipi. The results so far achieved go to show that these improved Co-varieties are much superior to the Red mauritius variety, both in tonnage and juice quality, and we hope that within the course of another 10 years, these Co-varieties will completely replace the Red mauritius variety which is fast deteriorating.

Sugarcane is mainly grown along the river basins, where the soils are well drained. It is regularly rotated with paddy, and heavily manured.

Preparatory cultivation. Soon after the harvest of the 1st crop paddy in October, the preparatory cultivation for sugarcane is started. The land is ploughed twice with the country plough and the levelling board is passed over. Then the land is ploughed at intervals and the bunds trimmed. With about 6 to 8 ploughings, the land is brought to fine tilth and early in December, ridges and furrows are opened with spades and human labour. The furrows will be 9"—10" deep and are opened at regular distances of a yard, the length of the furrows being short, to facilitate lift irrigation. The furrows are left for sun-drying for about a week before planting the setts. No manure is applied to the fields either during the preparatory cultivation or during planting.

Planting. December—January is the main planting season in the Kallianpur Sugar Factory area while the season extends up to February—March in other parts. Only the top setts of the canes are used for planting. During the harvest of the previous crop, healthy top setts are separated and topped with the leaf sheaths intact and bundled. These bundles are soaked in some shallow sweet water for a day and then removed and kept covered in a shady airy place, till the eyebuds begin their activity and start germination under favourable conditions of temperature. The setts can be preserved this way for about 3 weeks, because the development of the buds will be slow under cover of the leaf sheaths. The other method of curing the setts is to pit them in shallow pits and cover them over with some straw and a thin layer of earth.

When the land is ready for planting, the cured setts are taken out, stripped and cut into small setts with 3 to 4 nodes each. They are planted in the dry soil in the furrows and covered over with a thin layer of the fine soil, care being taken to plant the setts with their eye-buds on either sides. Now irrigation water is let in and a good soaking irrigation is given. The practice of trampling in the setts with irrigation, is not practicable in this sandy soil. It takes 12,000—15,000 setts to plant an acre.

The germination in the cured setts starts on the third day and will generally be very satisfactory. On the fourth day after planting, a light irrigation is given, followed by another light irrigation on the eighth day. The field is left dry for about 10 days, when all the buds germinate and then, regular irrigations are given once a week, till the onset of the S. W. Monsoon.

Manuring. Though the crop is manured heavily in this district, the manuring starts only when the crop is about 40 days old. The first manuring is done when the crop is about six weeks old, with 10 cart loads of farm yard manure and 100 lbs. of ammonium sulphate per acre. The manure is applied in the furrows and the crop slightly earthed up with spade and manual labour. This light earthing up serves as a hoeing and weeding to

the whole field. The second manuring will be, when the crop is about two months old, with about 10 cart-loads of either farmyard manure alone or a mixture of farm yard manure and fish manure or with 5 cart-loads of farm yard manure and 100 lb. of ammonium sulphate with a good earthing up. Then there is the final manuring with about 20 cart-loads of 'burnt earth' per acre and earthing up. The burnt earth is prepared by burning the trash and stubbles of the previous sugarcane crop mixed with a good quantity of the top soil of the field with a slow fire. When the manuring is over, the crop is finally earthed up and drainage channels are dug in the fields, soon after the first trashing is given, in the first week of June with the onset of the S. W. monsoon.

Other operations. During the monsoon, trashing the canes is the only operation. Trashing is done once a month and in places where there are attacks from jackals, wrapping also is done simultaneously.

Harvesting. The harvest season extends from October to February. The early planted crops are harvested in October to take advantage of the early market. No irrigation is given to the crop even if they are left in the field till February. Harvesting is done by digging out the clumps with a 'quintany' (pickaxe) to get even the root portion of the canes for milling.

Milling. Iron mills have completely replaced the old wooden mills in the area. Mills are set up near the fields and two boilings of 18 Kerosene tins (72 gallons) of juice each, are taken every day. It requires two pairs of animals and two men per day, to take two boilings. The crushing percentage and the recovery are satisfactory, being about 65% and 10% respectively. Most of the sugarcane cultivators engage their own pairs and labour for the manufacture of jaggery.

Side by side with the harvest, the planting operations of the new area are taken up.

After the harvest of the crop the land is used for the cultivation of the first crop of paddy.

Cost of cultivation :— The following figures give the details of the cost of cultivating an acre of sugarcane.

1.	Preparation of land.	Rs.	9	10	0
2.	Ridging and furrowing.	Rs.	7	8	0
3.	Cost of manures.	Rs.	61	0	0
4.	Manuring.	Rs.	11	0	0
5.	Cost of seed setts.	Rs.	15	0	0
6.	Planting.	Rs.	4	4	0
7.	Irrigation.	Rs.	44	0	0
8.	Final earthing up	Rs.	7	8	0
9.	After cultivation	Cost of trash			
10.	Harvesting topping, stripping, cleaning, bundling and transporting to the mill.	Rs.	13	10	0
11.	Lease or rental on the land.	Rs.	65	0	0
12.	Cost of preparing jaggery.	Rs.	81	0	0
13.	Transport charges @ 8 as per candy for 13½ candies,	Rs.	6	12	0
	Total expenses. ...	Rs.	326	4	0

14. Average yield of canes in tons per acre	...	30 tons.
15. Jaggery out-turn in candies of 500 lb.	...	13½ candies.
16. Value of yield at Rs. 42 per candy of jaggery.		Rs. 567 0 0
17. Net gain per acre.		Rs. 240 12 0
The following figures are of interest:—		
Cost of production of 1 ton of cane.	...	Rs. 7 15 0
Cost of production of a candy of jaggery.	...	Rs. 23 10 8
Transport charge per candy of jaggery to the market.	... ...	Rs. 0 8 0
Cost price of one candy when taken to the market.		Rs. 24 2 8

With the cultivation of the improved varieties of canes and the use of improved implements, it will be possible to reduce the cost of cultivation and increase the yield and thus it will be easy to increase the net income by about Rs. 50 per acre and Rs. 2,50,000 per year for the District of South Canara.

A Note on Arrow Root in the Salur Agency.

By P. SOMAYAJULU, B. Sc. (Ag)

Agricultural Demonstrator, Salur.

Indian arrow root, *Curcuma angustifolia* Telugu *Palagunda* is a wild plant growing in several parts of the Vizagapatam District. The starch prepared from the mature rhizomes is used for making milk puddings (Pala Munjalu) and it is usually prescribed as a diet for invalids. It is used as a diet during dysentry for its easily digestible qualities. The Agency taluqs of Pottanghi, Padwa, Jeypore and Nowrangapur of the Old Vizagapatam District are the chief places where it is extensively grown. The cultivation of this crop, in the sense of regular planting, interculturing and subsequent harvesting, is not regularly done in these tracts. It grows more or less wild in several blocks of waste jungle land, specially near hill streams. It thrives usually at an elevation of over 1500 feet where the soils are very rich virgin, red sandy loams. Because of its free natural growth in the hills whose elevation is usually about 1500 feet and where annual rainfall exceeds well over 50 inches and because of its abundance near water courses, one has to conclude that it requires a very rich loamy soil with plentiful water supply and a fairly cool atmosphere. Attempts will have to be made to see whether it grows well in the plains where water supply is abundant and the soil is fertile.

Preparation of the produce for the market:— The hill tribes gather the rhizomes and prepare the stuff for the market. When they are full grown, the rhizomes are dug out in the months of January and February and washed well in the streams to remove the soil. The washed rhizomes are then rubbed against pieces of stone and washed at the same time. The washings are collected in pots, filtered and the filtrate allowed to settle in shallow earthen-ware basins. The starch settles to the bottom leaving some supernatant liquid which is drained off after a while. Water is again added and the precipitate mixed well for a second wash and allowed to settle. The

supernatant liquid is again drained off. This process of washing and draining off continues until the starch is fairly white and much of the astringent and bitter taste of the same is lost and then it is allowed to dry in the sun. The dried stuff cracks well and crumbles into small pieces. The stuff is marketed as such in the local shandies. Merchants from Salur attend these shandies and buy it in the season @ 10 to 12 (addas) measures per Rupee and sell the same in the local market at 5 to 6 measures a Rupee. Much of it is exported to Vizianagaram and Vizagapatam markets as well. This is usually adulterated locally with rice starch or maize flour (Maida). These latter are mixed with water to make a thick paste and dried in the sun and broken to pieces to resemble the pure Palagunda. But experienced merchants can find out the difference between the adulterated and pure stuff, by the characterestic flavour of the latter. Palagunda also comes to the market from the Raipur side and this too is invariably adulterated as stated above.

While digging out the rhizomes, a few are left in the soil at each clump, for the next season's growth. With the advent of the monsoon, the crop grows luxuriantly and is again harvested in the months of January & February as stated above. No attempts at manuring the crop or any other cultural operations are made. Under proper cultural practices this should form a paying cottage industry and it is worth while trying to grow it in the plains where conditions permit. Improvements can also be suggested in the matter of preparation of the produce for the market. Instead of rubbing the rhizomes on stones they can be pounded in wooden or stone mortars and the pulp washed in water and filtered, and, the filtered stuff prepared for the market as usual.

SELECTED ARTILCE

Science and the Indian Peasant.

By SIR E. J. RUSSELL. D. Sc., F. R. S.

Director of the Rothamsted Experimental Station.

The main facts of the agricultural situation in India so far as the peasant is concerned are set out in Table I. From this it appears that the population is increasing more than the area of land sown to crops; and, further, there is an increasing tendency to grow more saleable crops and less food crops, i. e., to get money rather than food out of the land.

TABLE I. Areas of Land Cultivated, and Utilisation per Head of Population, British India.

	Area in million acres.				
	1915—16 to 1919—20	1920—21 to 1924—25	1925—26 to 1929—30	1930—31 to 1934—35	1936—37 to Provisional.
Net area sown	220·7	222·0	226·4	229·1	231·9
Irrigated area	47·4	47·0	47·9	49·9	51·7
Food crops	210·6	209·5	208·7	214·7	216·7
Non-food crops	42 6	43·8	49·4	47·5	50·8
Fallow	54·2	51·1	49·6	49·8	48·6

	Areas per head of population.					
	1903—04 to 1907—08	1908—09 to 1912—13	1913—14 to 1917—18	1918—19 to 1922—23	1923—24 to 1927—28	1928—29 to 1932—33
Net area sown	0·883	0·906	0·918	0·879	0·868	0·841
Food crops	0·829	0·862	0·879	0·833	0·803	0·785
food crops omitting sugar	0·818	0·852	0·862	0·822	0·792	0·774
Non-food crops	0·053	0·043	0·045	0·045	0·065	0·057
Population in Millions	273·6	243·8	245·3	246·9	259·2	271·5

The total of Food and Non-food crops exceeds the net area sown because some of the land is sown twice in the year.

On an average only 84 acres of land are used to produce the food of 100 heads of population, and in some of the more densely populated provinces only 66 acres, as compared with the 220 acres needed to feed 100 heads of population in Great Britain. Here, however, we need so much land because we eat so much meat : a vegetarian diet requires much less land and in consequence the diet in India is very largely vegetarian. Rice is by far the commonest foodstuff ; then come the millets; and finally, a long way behind, comes wheat which is further distinct in being confined to Northern India. The areas for the five-year period 1930—35 were, in million acres :—

Million acres : British India.*	
Rice	80·4
Millets	39·2
Wheat	25·7

The grain crops for human food thus form about 77 per cent. of the total sown area. Fruits and vegetables occupy about 2 per cent of the area sown, sugar 1·4 per cent. and other miscellaneous foods bring the total up to 82 per cent., while the remaining 18 per cent. includes 4 per cent. fodder crops, and 14 per cent of oil seeds, fibres and a few others. The comparison with English agriculture is very striking, grain crops occupy only about 7 per cent. of the cultivated area in England and Wales ; on the other hand fodder crops for animals which form only 4 per cent. of the cultivated area in India constitute some 25 per cent in England and Wales, to say nothing of all our grass land, which adds another 60 per cent., making a total of 85 per cent. of cultivated land devoted to the production of animal food.

A remarkable feature of Indian agriculture is that the area under food crops per head of population has been falling ever since the period 1913-18, when it stood at 0·87 acres, a figure to which it had been steadily rising for at least ten years ; it was in 1928-33 only 0·78 acres, a figure lower than in any of the five preceding five year periods. On the other hand, the area under non-food crops, i. e., cash crops and others, has steadily risen as the food area has fallen, and in the 1928-33 period stood at 0·57 acres per head against only 0·45 acre per head during the 1913-18 period. Three possibilities present themselves. Yields of food crops may have risen, so that the total production of food is at least as great as ever; or the money from the cash crops may be used for buying food, thus possibly adding variety to the diet ; or the peasant may be getting less food than he was during the 1913-18 period. It is difficult to decide between these possibilities. Agricultural statistics in almost all countries are subject to error, especially statistics for yields. In large parts of India even the acreage figures are uncertain and figures for yield still more so shall not attempt to discuss whether yields have gone up or down, or whether the total human food

*Provisional figures for 36-37 are Rice 81·7, Millets 39·0, wheat 25·2.

production per head is better or worse than in 1913-18. The more important question is whether the present food production per head is adequate, and, if not in what directions it needs improving, and how this can be done.

The question of adequacy of diet is one for medical authority and not for an agriculturist. The present Viceroy is deeply concerned with the welfare of the peasant and is encouraging full investigations into this question. A Human Nutrition Research Institute has been set up at Coonoor in the Nilgiris under the very able direction of Dr. W. R. Aykroyd, and he has provisionally suggested as the average daily requirement of a man in India, 2,600 calories, 65 grams of protein (10·4 grams of nitrogen), 45-60 grams of fat, 20 mgs. iron 0·6 gram calcium and 1 gram of phosphorus. The uncertainty about the average yields per acre makes it impossible to estimate accurately the total quantities of food produced in India, but from a number of sample enquiries it is reasonable to think that the total production satisfies both the total calorie and the total nitrogen requirements, though with little margin of safety. Dr. Aykroyd, however, emphasises the importance of biological value of proteins as well as nitrogen content, and shows that animal proteins are biologically more efficient than vegetable proteins; he suggests that they should form at least one-fifth of the total protein in the diet. Milk, even skim milk, he points out, is the best for growing children, but eggs, fish and meat are all good sources.

These foods are almost certainly consumed in inadequate quantities. More serious is the lack of vitamins, especially of A and B; this is confirmed by the prevalence of the deficiency diseases caused thereby; Keratomalacia caused by deficiency of vitamin A; stomatitis due to deficiency of Vitamin B, and low haemoglobin content of the blood due to iron deficiency. The agricultural problem is thus threefold: (1) to increase the total production of foods so as to widen the margin of safety; (2) to increase the production of milk and other animal products so as to improve the biological value of the proteins; (3) to increase the supply of vitamins, of calcium, phosphorus, and other mineral substances.

So far we have been dealing only with averages over the whole country. But India is very vast, and it comprises many widely different regions and groups of people, and it would not be easy to ensure that every part and every class should be self-sufficing in the matter of food production. There must always be exchange between one place and another and hence it is important to increase the value of the cash crops so that the peasant may have the necessary money to buy the things he is not himself producing. This then gives the agriculturist his fourth task: to raise the value of the cash crops; which means improving both their quantity and quality.

These tasks may be achieved in two ways: by increasing the area of cultivable land or raising its level of output; and by improving the crops. Both methods are being adopted. There is still a considerable area of land in British India not yet cultivated, but a large part of this could be cultivated only with difficulty: —

Utilisation of land area, 1935-36, British India.

	Million acres.
Net area sown	228·7*
Culturable waste, other than fallow ...	153 1
Area uncultivable	146·0
Forest	89 8

The more hopeful method is to improve land already in cultivation so as to increase the yields and to widen the scope of cropping. The most efficient method of doing this is, in general, to irrigate it, for of all causes of infertility in India, shortage of water is the most widespread and serious.

* Not including 51, 399, 765 of fallow

Irrigation is done in three ways: (1) by wells, (2) from tank, (3) from dammed up rivers, by means of canals. Nearly a quarter of the sown area in British India is irrigated, and of this about half is watered by canals and about a quarter by wells:—

British India.		Million acres. 1934–35	1936–37.
Irrigated by-Canals ...	...	26	
Wells ...	...	12·5	Provisinal.
Tanks and other methods	...	12	
	Total	50·5	
Total area sown... ...	...	227	
Percentage irrigated ...	...	22	

All these methods of irrigation are ancient but the old method of irrigation from wells, when the lifting is done by bullocks, leaves perhaps the most abiding memory of Indian village life on one's mind. The monotonous journeying to and fro; the creaking of the windlass; the swishing sound of the water as it is discharged from the bag or bucket; these things one can never forget. The most striking contribution of science to well-irrigation has been the development of tube wells carried out to a notable extent in the Punjab and adjacent regions, where the subsoil carries plenty of water. This method has been well developed by Sir William Stampe and in places is combined with washing and bathing facilities, so that the well really becomes a centre of life for the inhabitants. Tube well irrigation is largely used for sugarcane and other valuable crops.

Irrigation from canals has been greatly developed under British rule, and indeed if the British connection with India had done nothing else, it would deserve to be remembered always for the enormous dams and irrigation systems we have set up, in order to ensure the maximum of beneficial use of the water that flows down from the Himalayas and other mountains, and might, if left alone, do great harm or at best only run to waste. I need mention only one: the great irrigation system in Sind, in which the waters of the Indus are distributed over a vast area of what would otherwise be of low productivity or even desert, converting it into fruitful land. The opening of the great Lloyd Barrage in 1932 had already brought into cultivation some 600,000 acres of land by 1935–36, besides adding greatly to the areas under cotton and wheat :—

TABLE 2. Cropping in Sind before and after the setting up of the Lloyd Barrage in 1932.

Crop	Acreage in thousands.			Production, tons in thousands		
	1913–14 1917–18	1923–24 1927–28	1933–34 1935–36	1913–14 1917–18	1923–24 1927–28	1933–34 1935–36
Cotton	264	339	649	...	...	...
Wheat	594	441	1,157	237	93	278
Rice	1,166	1,148	1,097	399	455	403
Juar*	617	549	466	187	118	103
Bajri†	679	1,064	854	164	150	99
All grain crops except wheat	3,188	3,276	2,921	814	807	669
Fruit and vegetable	44	46	49	...	...	...
Oil seeds	404	299	194	...	...	...
All crops	4,609	4,554	5,141	...	...	...
				...	...	...

* Chiefly in Upper Sind.

† Chiefly in Middle and Lower Sind.

‡ Two years only 1934/35.

The production of cotton and of wheat has greatly increased: that of rice shows little change, but the millets and other grain crops have fallen off considerably, so that the total production of grain is less than it was. Nevertheless the cash value of the produce has much increased.

The setting up of an irrigation system is a task for the engineer, but when he has finished and retired with honours, the difficulties of the agriculturist begin. First is the question of seepage water. The canals are rarely watertight; they let the water ooze out and waterlog the adjacent soil. Many acres of agricultural land have been ruined in Sind, and whole villages have suffered subsidence. Then, there is the question of salt. Sooner or later salt nearly always appears in irrigated regions. It comes up from some lower layer of the soil where perhaps it had done no harm to the crops; it reaches the surface and spreads, killing every useful plant it touches. Both sets of problems are difficult and require for their study, a good deal more fundamental investigation than they are getting. Other problems are more definitely agronomical: such as the choice of suitable systems of cropping and varieties of crops; methods of manuring; optimum quantities of water and times of application.

But all these problems are difficult, and require the services of an exceptionally competent staff. Such men are rare, and they cannot be produced by mere training. Men not up to the necessary high standard may involve the cultivators in serious loss and do irreparable damage to the whole irrigation system. These irrigated regions properly managed are a great triumph for human enterprise but there lie always within them the seeds of great tragedy.

The Punjab Irrigation Research Institute at Lahore is doing some very good work under Dr. E. McKenzie Taylor.

In regions where irrigation is impossible, but where crops usually suffer from drought, it is frequently possible to adopt special devices for making the most of the water that actually reaches the soil. These include the setting up of bunds and various cultivation devices grouped under the general name "Dry farming methods". They have been effectively studied in the Bombay Deccan.

The improvement of crop yields is effected by finding or breeding better varieties than those in common use, and by raising the level of production by better cultivation, more efficient manuring and management, and by better control of pests and diseases. I shall deal with the chief crops important to the peasant.

Rice is by far the most important crop in British India occupying 84 million acres out of the 215 million acres devoted to food crops. An enormous number of varieties occur in India of widely different types, some of them of great scientific interest, and much work has been done in classifying them, in selecting the more promising, and in breeding new sorts. The foundations were laid by G. P. Hector in Bengal and F. R. Parnell in Madras, and much subsequent work has been done by K. Ramiah at Coimbatore, and others. Rice is peculiar among grain crops in that many of its varieties are semi-aquatic and others entirely aquatic in their habit of growth, and this, of course, means that their manuring and cultivation are on quite unusual lines. The scientific problems associated with the growth of rice are thus of exceptional interest. They are also, however, very difficult, and the experiments have often to be carried out under very trying conditions; they involve puddling about during the hottest part of the day in gum boots in a muddy swamp infested with leeches and snakes, and made more disagreeable by mosquitoes and other insects. In spite of all this, a great number of investigations have been made, and a considerable acreage—3·6 million acres out of 84·3 million or 4·3 per cent of the total area is now sown with improved varieties. It cannot be confidently asserted however, that there is any

increase in the amount of rice produced; apparently, the acreage has somewhat decreased, and it is sometimes stated, though on no good evidence, that the yields have actually not yet come to full fruition.

The *Millets* come next in importance to rice; many different sorts are grown, the commonest being Juar (*Andropogon sorghum*), Bajri (*Pennisetum typhoideum*) and Ragi (*Eleusine coracana*) : the acreages are :—

	Million acres 1936–37.		
	British India.	Indian States.	All India.
Juar	23·1	13·0	36·1
Bajri	11·1	4·0	15·1
Ragi	3·7	2·8	6·5
Total ...	37·9	19·8	57·7

The millets differ fundamentally from rice in that they are dry-land crops and may receive no water except what the rain brings, though of course, if irrigation water is available it is given. They are sown just about the time the monsoon breaks so that they may obtain all the rain that comes, and they are indeed the chief crops in the non-irrigated and dry farmed regions. This great contrast with rice, explains why the two crops so often appear as complementary where the acreage of one is high, the acreage of the other is low, and *vice versa*.

Until recent years, there has been little scientific work done on the millets in India, but investigations have been started at Coimbatore, at Indore and also in connection with various dry-farming schemes. A few improved varieties have been found, but they have not spread, and the peasant has as yet derived but little benefit from the labours of the scientist.

Wheat. In regard to wheat, however, the story is quite different. Here, however, the problem was different. When the British scientific workers started investigations on wheat, their purpose was to select varieties suitable for the British market, so that the export trade might be improved. The Howards were the founders of the modern work on wheat in India. David Milne studied the Punjab wheats and other workers have followed; their efforts have been so successful that some 20 per cent. of the wheat area in 1934-35 was sown with improved varieties. The word " improved, " however, needs some explanation. Quality in crops is an ambiguous term; the layman often thinks it means high nutritive value; actually it generally means commercial desirability, which in the case of wheat is suitability for the English miller who will use it for blending and is not concerned with its nutritive value. In so far as Indian wheat is intended for the British market, this is obviously the standard to take. But the consumption of wheat in India is increasing, and it is estimated that some 45 per cent of the total Indian production is now consumed in the villages. In view of this changing market, obviously Indian requirements in India the wheat is not made into loaves, but into chappatties, something entirely different. It might be urged that India cannot spare grain for export, but against this, is the cogent argument that an export trade in good years affords a sure guarantee against famine in bad years. I shall not argue this question of policy, but only point out the desirability of discovering the properties needed for the making of good chappattis, and if necessary, producing and cultivating varieties of wheats possessing them.

Special reference should be made to the work on rust now being done in Northern India by K. C. Mehta.

Barley. This crop, like wheat, is of importance only in parts of Northern India; it occupies only about 6½ million acres in all British India, most of which (4·17 million acres) comes in the United Provinces. Of the rest 1·2 million acres are grown in Bihar and Orissa and 0·6 million acres in the Punjab. The barleys are of the 6—rowed type, and as these are used by English brewers, efforts have been made to breed barleys suitable for the English market. These have met with considerable success, and the Experiment Stations have sent over to this country samples which have been favourably reported on by the expert Committee of the Institute of Brewing. As in the case of wheat, however, large-scale industry has not kept pace with the plant breeder or selector and the commercial lots coming to this country fall far below the quality of the plant-breeders' samples.

We now turn to the cash crops. The two most important are cotton and sugar, but I shall confine myself to sugar partly for considerations of time, but chiefly because I studied it in more detail during my Indian journey. India is the second largest consumer of sugar in the world: the first is the United States, which in 1934—35 consumed 5·87 million metric tons; the third is the United Kingdom with a consumption of 2·28 million metric tons; while India comes in between with a consumption of 3·35 million metric tons. An assured and abundant supply of sugar is essential to India's happiness. Some 80 per cent of the sugar is eaten as gur, or Jaggery as it is called in the south; this is the yellowish or brown mass produced on evaporating the juice of the sugarcane in an open pan; there is a certain amount of clarification. Gur has always been made in India. But about a million tons of white sugar a year are consumed also, and much of this till recently was imported. Now, however, it is practically all made in India. The production of sugar is shown in Table 3:

TABLE 3. **Sugarcane crop. Acreage and Production.**

Province and States	Area (in thousand acres) 1935—36	Area (in thousand acres) Average of five years 1930—1 to 1934—5	Yield (in thousand tons of raw sugar (gur) 1935—36	Yield (in thousand tons of raw sugar (gur) Average of five years 1930—1 to 1934—5
United Province (including Rampur states)	2 249	1,597	3.336	2,063
Punjab...	473	446	358	336
Bihar	465	313	668	371
Bengal	325	224	560	330
Madras	131	114	360	322
Bombay (including Sind and Indian States)	121	99	313	256
North-west Frontier Province ...	58	49	63	55
Mysore	50	38	53	36
Hyderabad ...	59	38	99	60
	3,931	2,918	5,810	3829

*From Department of Commercial Intelligence and Statistics, in India Trade Journal Supplement, May 21st 1936.

The figures were still higher in 1936—37 though they appear to have fallen in 1938—39. The establishment of sugar production in India on so firm a basis is the direct result of the breeding experiments started by Dr. Barber, and especially his happy crossing of *Saccharum spontaneum* with the sugarcane, which yielded new varieties of great vigour and power of growth. This work has been ably

continued by Rao Bahadur Venkataraman and in consequence, India is now provided with a number of varieties suited to the various regions. These new sorts have almost ousted the old ones; some 80 per cent. of the area planted with sugarcane is under new varieties. Notable advances were made in the cultivation methods by G. Clarke at Shahjahanpur (1912—1930). Much of the success of the sugar industry is due to the improvements effected by technical chemists and engineers in the factories under the stimulating influence of Sir Harcourt Butler, and there is still scope for further efforts.

Fruit and Vegetables. I have spoken earlier on the shortage of vitamins in the ordinary diet of the peasant. An obvious remedy is an increase in the consumption of fruit and vegetables. A wide range of fruits can be grown in India; ordinary European fruits in the hills of the north and tropical fruits in the plains. Much work is now being done on the subject, though it is not clear that the area under these crops has yet increased. No area figures are available, but it is estimated that about 2½ million acres are devoted to fruit.

Milk and livestock. There is a fair consumption of milk in parts of the Punjab and some of the hill districts, but in general, the consumption is far too small. It is stated that the average daily ration of milk in the Punjab is 10 oz. while in Bengal, Madras and the Central Province it is only 2 oz. or less. This is bound up with the general livestock problem which in India is very difficult and is complicated by the fact that the Hindus regard the cows as a sacred animal and refuse to kill ineffective animals; in consequence the meagre supply of animal food has to be spread over a large animal population, many of which give no adequate return.

Dr. Norman Wright recently reported on this milk question so that it is unnecessary for me to discuss it. Scientific work on the subject is being done, subject to the limitations inherent in the problem. One hopeful line is the improvement of the grazing lands in the forest areas as this deals also with another difficult problem, soil erosion, which, however, lies outside the scope of this lecture.

The effect of the improvements resulting from scientific investigations. Table 4 shows the approximate areas sown with improved varieties. The greatest success has been with sugarcane. But wheat and rice represent a considerable achievement in view of the large acreage involved. It must be remembered that there is no honest seed trade in India which can take over the multiplication and distribution of improved varieties of crops. as is done in Great Britain; all this in India must be done by the overworked officials of the Department.

Time does not permit any description of the advances made by scientific workers in knowledge of the fertilizer requirements of crops, or in methods of cultivation but these have been considerable. Under the Imperial Council of Agricultural Research, further great improvements may confidently be expected.

The full result of the scientific work, however, is not shown in this Table but rather in the high levels of yield and quality obtained at the experiment stations. These are not infrequently double or treble the yields obtained by the peasants. The great problem in Indian agriculture is not so much to acquire new knowledge as to bridge this gap between peasant practice and experiment station achievements.

The Causes of Frustration of Agricultural Science in India. There are several reasons for this wide gap, but in my view the two most potent are the poverty of the peasants and the lack of an educated agricultural middle-class.

There are, of course, many zamindars and other landlords and farmers who take a direct interest in their land and their people, and who do much to raise the standard of farming. But they are exceptional, and broadly speaking there is a serious lack of leaders in the agricultural community to take over agricultural improvements from the experiment stations and put them into practical form modified to suit the local conditions. The educational system has not produced this type of man and although there are agricultural colleges, the students only rarely take up farming.

TABLE 4. Approximate proportion of area sown with improved seed.

Crop.	Total acreage. Million acres.	Acreage under improved seed. Million acres.	Percentage.
Sugarcane	4·10	3·27	81·7
Jute	2.18	1·3	58·6
Wheat	33·61	8·5	25·3
Cotton	26·00	5·04	19·20
Rice	83·43	4·58	5·5
Groundnuts	5·86	0·22	3·40
Millets	38·69 *	0·34 ‡	Not calculated as figures
Gram	16·90	0·33 ‡	are incomplete

*Including Jawar, Bajra and Ragi only.

‡ Not separately reported by some provinces.

In their defence it must be said that the acquisition of agricultural land by an outsider is often difficult, and the villages are singularly unattractive places in which to live. Poverty, dirt and disease are still rife in spite of years of effort to get rid of them. But at last the efforts are beginning to tell; a widespread movement for improving village life is being fostered, not only by the British but also by the best of the Indians themselves, and is spreading over the country. Already many of the villages have been cleaned up; wells have been walled in; the streets freed from garbage and other refuse which is now used to make compost heaps; mango trees have been planted and the roads improved. We can only hope that, when the villages become fit for educated people to live in, they will go and live there. Already a beginning has been made in the Punjab for example, steps have been taken to settle graduates on the land and some 8,900 acres of land have been colonised by 162 educated young men, of whom 89 comprise the entire cultivating population of four villages and the remainder are scattered in pairs, over villages where it is hoped they may exert a profound influence for good. But in the meantime, many of the agriculturists are too poor to be able to undertake any but the simplest changes. Many of the peasants are very shrewd, with a considerable knowledge of their soils and crops. But they are hampered by ineffective cattle and implements, by lack of manures and by lack of money. Special methods are needed for passing the knowledge gained at the experiment stations over to the peasant and showing him how to use it in his daily work so as to reduce the poverty which at present so much hampers progress. What India needs now is not so much new scientific knowledge about general agriculture, but fuller use of existing knowledge and the working out of methods to reduce the present wide gap between the ordinary cultivator and the experimental farm. Fortunately all parties seem to have agreed on the vital necessity of improving the lot of the peasant, and we can look forward with confidence to the result of the many beneficent agencies working to this end. (*Journal of the Royal Society of Arts*, No. 4512 May 1939).

ABSTRACTS

Little leaf—A transmissible disease of brinjal (*Solanum melongena*) by K. M. Thomas and C. S. Krishnaswami: *Proceedings of the Indian Academy of Science.* Vol. X, No. 2. August 1939; 201—212 2 Pl.

A disease of brinjal (*Solanum melongena*) causing reduction in the size of leaves, shortening of internodes, stimulation of axillary buds, phyllody and sterility, prevalent in many parts of South India was investigated by the authors. The disease was found to be transmissible from diseased to healthy plants by grafting, and not by sap inoculation. A jassid '*Eutettix phycitis*' found on brinjal in Coimbatore was able to transmit the disease under experimental conditions, and would appear to be the chief vector of the disease in the field. The disease has a wide host range among solanaceous plants. Tomato, tobacco, *Datura fastuosa, Solanum xanthocarpum, and S. trilobatum* are the hosts mentioned. The disease could be controlled by roguing affected plants, and removal of solanaceous weeds from the field.

The absence of any constantly associated organism in the affected plants together with the general nature of the disease lead the authors to conclude that, the disease is of virus origin. (Authors' abstract).

Seasonal variations of starch content in the genus Rosa and their relation to propagation by cuttings. Brandon, D., *Jour. Pom. and Hort Sci.* Vol. XVII. 233—253. 1939.

A series of experiments were carried out to ascertain the rooting capacities of various varieties and species of rose. Hardwood cuttings were taken at intervals during winter and the highest rooting percentage was obtained during the period October-December. Soft wood cuttings were inserted in summer and June was the best time for rooting.

The cuttings were exposed to various chemical treatments before planting and B-indolyl acetic acid (1/10000 to 1/50000) and glucose (1%) increased rooting percentage slightly. No treatment was found to give a pronounced increase or acceleration in rooting. Two different pH values of the solutions used had no effect on subsequent rooting.

The different varieties and species showed varying types of starch fluctuation during the season, falling into two groups.

The value of plant hormones or their substitutes in plant propagation. W. T. Brown., *Malay. Agric J.*, 1238, 26; 414-9, **bibil. 12.** The general principles of the functions of plant hormones in root production are described and the application to practical horticulture of the knowledge now available is discussed. Plants may be classed as to their normal habits of rooting from cuttings, as easy, but slow, and difficult. The easy ones require no treatment with synthetic growth substances though they respond well to them by accelerated rooting. The easy but slow are usually evergreens which take a year normally but when treated will root in 6 to 8 weeks. Efforts to strike difficult cuttings by the aid of growth substances have not been markedly successful. In all cases response to synthetic growth substances has been largely confined to leafy cuttings; leafless cuttings seldom respond. *Horticultural Abstracts 9 (1939)* : 8.

Application of growth substances to increase rooting capacity in cuttings of woody species and shrubs. D. A. Komissarv. C. R. Acad. Sci. U. S. S. R. (Russian) 1938, 18 : 63—8. Winter and summer cuttings of 18 deciduous trees, shrubs and conifers were treated with 0·020 to 0·001 % water solutions of B—indolylacetic acid for 6 to 72 hours. Results are tabulated. A higher percentage of rooted cuttings, greater root system and earlier rooting was determined

after application of the optimal concentration, which varied from 0·02 to 0·005 % according to species. An interesting result was achieved with *Picea excelsa*, the cuttings of which are difficult to root. Cuttings made in June and treated 24 to 32 hours with 0·005 % solution of heteroauxin rooted up to 93 %. The effect of phenylpropionic, phenylacetic acid, anaphthalene acetic acid, urine and maize flour extract was similar but less pronounced than that of heteroauxin. The compounds proved ineffective on some species. The effect of growth substances depends on the plant species, age of plant, wood development and time of taking cutting. (*Horticultural Abstracts* 9 (1939) : 6)

EXTRACTS

Silage making by the Forest Department. The Forest Department experimented for the first time in Kurnool District with making of silage to serve as fodder for cattle during the hot months.

Two pits were dug each 10 feet by 15 feet and eight feet deep in Sidhout and Vontimitta Ranges of this Division. These pits were filled with green grass on 29th September 1938 and 21st October 1938 respectively.

In the pit in the Sidhout Range, 11·02 tons of fodder grass *Heteropogon contortus* (spear grass) and *Schema nervosum* (*nendra* grass) were put in. The weather was wet at the time of collection and of filling in of pits and the pit had to be covered with a tent to prevent rain getting in.

In the pit in Vontimitta Range, 10 tons of grass were loaded mostly *Heteropogon contortus*. The weather was not so wet in September and that probably accounted for the difference in weight in the two cases, the dimensions of the pits being the same. Grass was well pressed in the pit and trampled by cattle. In the green state, it stood two feet above ground level. Earth was banked on four sides and a top covering of two feet of earth laid, after all the grass had been loaded, to make the pits water-tight. Gradually the pit contents shrank to about six feet depth from bottom with the weight of the load of earth on top. The earth was shaped pyramid fashion to drain off water on all sides.

The pit in Sidhout Range was opened on 13th April 1939, i. e., eight months after formation, to see what the silage was like. About 100 cattle were brought from neighbouring villages to feed on the silage. The cattle greedily ate the silage offered. The Deputy Director of Agriculture who was present when the pit was opened pronounced it to be quite good.

The grass in the pit when first opened was quite warm to the touch and had a sweetish, tobacco smell—not quite offensive and yet not pleasant.

The cost of construction was as follows :—

Construction of pit	Rs. 7—4—0
Collection of green grass at annas four per bundle of 150 lbs.	Rs. 41—3—0
Covering, etc.	Rs. 4—0—0

The silage taken out was offered free to cattle that were invited to the feast. Quite three-quarters of a ton was thus distributed free. The balance—about 6 tons—was sold to ryots who readily purchased it at nine pies per 60 lbs.

The only criticism which the Deputy Director had to offer was that we did not cover up the top and sides of the grass heap with mat or green leaves to prevent soil mixing with the edible silage.

We propose to try making silage with bamboo leaves and *Yepi* (*Hardwickia binata*) in other centres. From the way the ryots appreciated this demonstration, it looked as though it would not be difficult to persuade the influential ryots in

forest villages to try this method of storing green fodder in time of scarcity. If our experiments with bamboo and *Hardwickia* also succeed, it should not be difficult to get a little revenue too by this method of preserving green fodder for cattle.

The Deputy Director of Agriculture lucidly explained in Telugu the method of forming silage and its use in times of scarcity. (*The Indian Forester*, LXV (1939) 582—583).

The Cultivation of Cinchona in India. It appears probable that we shall soon be having a big development in the cultivation of cinchona in India. Towards the end of the year 1937 it may be recalled that the Imperial Council of Agricultural Research, set on foot an enquiry into the prospects of cinchona cultivation in India and appointed Mr. A. Wilson, Deputy Director, Cinchona, Madras to conduct the enquiry and also associated with him Dr. T. J. Mirchandani, Agricultural Chemist, Bihar, as Soil Chemist. The Report of these officers which has just been published as Mis. Bulletin No. 29 of the Council, goes fully into the subject, giving an account of the present situation and prospects and an equally interesting survey of the nature and extent of the efforts in the past. It may not be generally known that India is already a fairly large producer of quinine from locally grown cinchona bark and that in the past it was producing much larger quantities. The present annual production is put down as some 70,000 lbs. of quinine; until about the year 1880 she was a much larger producer, the estimated quantity of bark per year at that time being as much as 950 000 lbs, or an output of nearly 2 lakhs pounds of quinine—facts which amply demonstrate that India has the soil and climate suitable for producing a large quantity of her requirements of the drug. This important factor, viz, India's requirements, is estimated variously. The author estimates it at 6 lakhs of pounds. He also refers to other authorities who estimate it at 12½ lakhs of pounds or over twice the first estimate. This is further complicated by the fact that in reality, India is consuming only 210,000 lbs. per year or only a third of the lesser of the above two estimates. An account is also given of the difficulties which the Government met with, in disposing of their stocks; comsumption fell from 80,000 to 60,000 lbs. even though prices became cheaper by 30 per cent. and the demand could not be increased even when the stock was offered for sale at a big sacrifice in price. Altogether we cannot help thinking that this matter of the quantity which India will absorb is decidedly obscure and needs to be clarified. We wish also that a statement had been furnished to show the consumption per year for a period of, say the last 10 or 15 years. Anyhow the report takes 210,000 lbs. of quinine as the annual requirement; of this quantity local production supplies at present 70,000 lbs. and the remainder is imported. The immediate objective therefore is to grow enough cinchona in the country to produce this 140,000 lbs. of quinine that is now imported. The report further envisages the need for producing the much larger quantities referred to above and contains suggestions to that end also.

Land considered promising for cinchona cultivation in many parts of India, notably the planting districts of South India, Assam, Bengal and Orissa, and the Andaman Islands have been surveyed, soil analyses and profile studies made, and the requirements in this regard discussed.

Altogether, an area of some 38,000 acres have been specified as suitable and additional tracts are indicated for further similar inspection, if a much larger production should be contemplated, though for the planting programme of twelve years at the rate of 3,333 acres annually stated as required for the latter larger production, this 38,000 acres appear sufficient. Government planters and small holders are all suggested as suitable agencies for the growing of the plants. We

may point out in this connection that no information to show what money return can be expected from the cultivation of cinchona is available in the report, although this is an all-important factor, at least as far as the private planter is concerned whether large or small. The cost of production is however given in detail; a statement of the prices paid for bark, or the unit price that has ruled for the last ten years or so, will have greatly added to the usefulness of the report. We should also like that analyses had been given of the soils of certain Anaimalai estates where bark with a high quinine content of 11% was being produced, and likewise of the soils of the Tavoy plantations which are stated to have been a disastrous failure although the area was selected by one of the greatest experts in cinchona.

The species *ledgeriana* is the one recommended to be grown. It is gratifying to learn that 72% of the cinchona grown in India at present is *ledgeriana*, and that among these some extraordinarily good areas may be seen. The need for research is emphasised on the famous Java model and a strong plea put in for a research station for isolating better performing strains of *ledgeriana*, for their multiplication as plants on their own roots or grafted on to *succirubra* stocks, for nursery technique and so on. Such a station is in our opinion long overdue.

Much has been accomplished even as the result of grafting the *ledgeriana* on to the less exacting *succirubra* in Java, a comparatively easier line of work which we are told is being done with great facility by ordinary coolies trained for the work, at the rate of some 300 to 500 grafts per day for a set of two coolies; it should be possible to undertake this work at least straightaway on the present Government plantations themselves. It is stated that this was attempted but was not persisted in. The point is further stressed that unless this better species and better yielding types among them are grown, it will not be possible to reduce the cost of production. This cost of production will probably be the rock on which schemes of expansion and continuance will split; motives of self-sufficiency are not likely to stand the strain of the ever present and insistent claims for economy, especially if large supplies of cheaper quinine should be available from Java or other foreign sources. The lines of expansion indicated in the report are cautious and sound: we hope suitable action will soon be taken to give effect to the recommendations. (*S. K. Y. in Current Science*, Vol. 8. No. 9 September 1939).

Gleanings.

Spraying and Photosynthesis. The application of a spray fluid for the control of insects or fungi has usually been regarded solely from the pathological point of view. R. A. Hyre has shown, however (Cornell Univ. Agr. Exp. Sta. Memoir 222, Ithaca, N. Y, April 1939), that certain sprays lower the photosynthesis of the plant to which they are applied. Lime-sulphur may even reduce it by as much as 28 per cent at ordinary summer temperatures, but Bordeaux mixture, on the other hand, has little effect. Emulsified sulphur pastes were found to be intermediate in their effect upon photosynthesis. Respiration was not markedly affected by spray fluids. Studies upon such factors as the biennial bearing of tree fruits show that these plants cannot sustain any considerable loss of photosynthesis with impunity. The loss in anabolism through spray applications is not of many days' duration but it is likely to occur at the critical time of flower bud formation, when the extent of the subsequent year's crop is being determined. The use of Bordeaux mixture instead of lime-sulphur in the summer spray programme would provide a practical means for the achievement of pathological control without physiological disturbance. (*Nature*, Vol. 144, No. 3644, Sept. 2, 1939, p. 447–448).

The Control of Silver-fish. Silver-fish, at times, cause serious damage to the surfaces of photographs, book-covers, wall papers, starched clothing, linen and other materials. They shun the light, and unless disturbed are not often seen during the day. Cupboards and book cases, etc. which are not frequently used, provide shelter and breeding grounds for them.

Silver-fish are wingless insects and are covered with smooth, glistening scales, which in the common house species (*Ctenolepisma longicaudata*) are silvery grey in colour. The whitish eggs are small and rounded, and the young forms resemble the adults.

Control. Where silverfish are known to congregate in numbers and are readily reached by a spray, a kerosene-pyrethrum mixture (or fly spray) may be used.

The spray mixture may be prepared with the following materials :—

Pyrethrum powder.	4 oz.
Kerosene.	1 quart.
Methyl salicylate (synthetic oil of wintergreen).	¾ fluid oz.

Place the pyrethrum powder in the kerosene, mix and shake well, then allow to stand for about twelve hours. Strain through fine muslin and add the methyl salicylate, after which the spray is ready for use.

A poison bait which has been found effective in controlling silverfish may be prepared with the following substances :—

Flour.	1 oz.
Sugar.	1½ oz.
Barium fluosilicate.	1¼ oz.
Water.	½ pint.

To prepare, make the flour and sugar into a paste with the required amount of warm water and then stir in the barium fluosilicate.

The baits are readily prepared by spreading the poisoned paste with a paint brush on sheets of thin cardboard, about two feet square. Both sides of the cardboard should be painted, and when dry, cut up into small pieces measuring about two inches by three inches.

From 10 to 20 baits are used in an average-sized room, and they should be left undisturbed in parts where the silver-fish are usually seen. The baits should be kept out of the reach of children. "*The Agri. Gaz. N. S. Wales*", Vol. L, (1939) : 438.

A Simple Ant Bait. During the past three years very satisfactory results have followed attempts to clean up invasions by the small black ant, *Iridomyrmex rufoniger*, in houses in Sydney, by baiting with a relatively simple mixture of honey and arsenic. The bait is made by mixing :—

	By weight.
Arsenite of soda (80 % As_2O_3)	1 part.
Water.	16 parts.
Honey.	288 parts.

These proportions are most easily arrived at by stirring thoroughly into 18 oz. (by weight) of honey, 1 fluid oz. of a solution of arsenic containing 1¼ oz. of the arsenite of soda per imperial pint.

Commonly recommended baits for sweet-eating ants almost all contain very much more water than the above mixture and usually contain preservatives. They are more complex to prepare. Some at least lose their toxicity or attractiveness as a result of a mould growth when kept in partially-emptied bottles

Samples of the simple honey and arsenic bait stored for eighteen months in half-filled bottles grew no mould (presumably because of the high concentration of sugars), retained their odour of fresh honey, and were readily eaten by small black ants. As with freshly prepared bait, the colonies of ants observed fed on 18-months-old mixtures for some few hours and then disappeared. A small teaspoonful of the bait, or the amount adhering to half a dozen wooden matches dipped in it, was enough to give the desired result in several houses in Sydney. It is suggested that no more need be offered to any colony at a time. The amount of arsenic in a small teaspoonful of bait is approximately equal to a large medicinal dose for a human being (one-sixteenth of a grain). This honey-arsenic bait is not attractive to the small red ant, *Monomorium pharaonis.*—R. N. McCulloch, Assistant Entomologist in (*Agri. Gaz. of N. S. Wales* 50 (1939): 348).

Correspondence.

To

The Editor, Madras Agricultural Journal.

School Gardens.

Sir,

In the matter of School gardens, India is at present far behind other countries. In America and England they are found scattered all over the country. In a country almost wholly agricultural like India, the children should be taught not merely the ordinary indoor curriculum of the elementary school but advantage should be taken of the child's longing for the open air and for playing at work, to develop its powers of observation and the acquiring of practical information from the material provided in the school garden, for arithmetic, mensuration, drawing composition and nature study in a living actual form. A good many people look upon school gardening as having for its object the cultivation of a few vegetables and flowers and nothing more. Even so, it would be of some value in teaching the boys and girls to be neat and methodical, useful and resourceful. The possibilities and usefulness of a school garden, however, are far greater than this. The school garden teaches the children to become interested in plant life, to use their hands while realising that it is not undignified to work and to take a new interest in their surroundings. It also enables them to add fresh and often new vegetables to the home supply or to obtain a little money from their sale, as a result of their healthy out-door work. In other countries, it has been found that the school garden course has developed the children physically, mentally and morally, turning out healthy, bright and quick-witted children.

The training that a boy has received in the ordinary village school garden, even supposing that he is not going to earn his living as an agriculturist, will have developed in him the habits of industry, economy, thrift, method and resourcefulness and will have sharpened his powers of observation.

Some of the more important uses of school gardens are, to serve as object lessons in the cultivation of useful plants, to encourage children to establish gardens at their homes. If tackled in the proper way, the school gardens might serve as centres for the distribution of useful seeds of improved varieties of common seeds, together with information about them to induce the cultivator parents to take up the cultivation of a new or improved variety.

With land and labour available in the schools, it is now possible to start a garden which will repay its cost many times over owing to the cheapness with which seeds of excellent varieties are now available from seedmen. A

succession of the most favoured and easily maketable vegetables such as radishes, lettuce, cabbage, brinjals, amaranth etc., can be grown. Wherever the school garden exists, the children are being instructed in laying out plots, in recognising various seeds and weeds, the different useful grasses, and the useful and destructive insects and birds of the garden. The value of this branch of training is already shown by the interest it has aroused among the children and the willing co-operation which has been forthcoming. It is hoped that the Educational authorities will see their way to inducing more schools to maintain school-gardens.

In a few cases, it has been found that the parents of children attending the school look upon manual labour with contempt, they should know that it is just those countries where manual labour has never been looked upon as a bar to advancement that are the most advanced and wealthiest.

Thyagarayanagar, Madras, November 1939. Yours &c.,

S. Sundararaman

Research Notes.

The Yam leaf beetle

Galerucida biclor Hope, a pest of elephant foot yam (*Amorphophallus companulatus* Bl.) Elephant foot yam is subject to the attacks of two insect pests— *Galerucida bicolor* (Fam. Chrysomelidae) and *Hippotion celerio* (Fam. Sphingidae). Of these the former does some serious damage to the crop; in some years the loss due to the insect is said to be about one third of the total crop. The grubs feed on the leaves and at times the entire stems are also attacked. The adult beetles also feed on the leaves and make holes in them. The pest has been noted to feed under laboratory conditions on Colocasia also. It has been recorded from Malabar and Godaveri in the Madras Presidency and also from United Provinces. Dhera Dun, Nepal, Assam and Burma.

Eggs are laid in clusters in the soil at a depth of about an inch. The egg measures one mm. long and 0·75 mm. broad and is yellowish brown in colour, spherical in shape and sculptured When about to hatch it turns shining and creamy white in colour. The egg period is about 7 days.

The newly hatched grub measures 3 mm long and one mm. broad. It is pale black in colour and bears hairs and warts on the body. The grub feeds on the leaves of the food plant. The first moult is 5 to 6 days after the hatching and the second 4 to 5 days after the first moult. In 4 to 5 days after the second moult the grub enters the soil for pupation. Pupation is inside an oval chamber at a depth of an inch. The larval period is about 13 days.

The pupa is pale yellow in colour and measures 6·5 mm. long and 3·5 mm. broad. The pupal period is 8 to 9 days.

The adult beetle measures about 7·5 mm. long and 5 mm. broad. The general colour of the beetle is brown with black spots and patches on the dorsal and ventral surfaces. A description of the beetle is given by Maulik in Fauna of British India, Coleoptera, Chrysomelidae, (Galerucinae) pages 554 to 556.

Handpicking of the grubs and adult beetles was tried with success. Other methods such as dusting with arsenicals are under trial.

4—12—1939, Ag. Res. Institute, Coimbatore.

M. C. Cherian,
N. Krishna Menon.

Agricultural Jottings.

Market Report No. 20.

TIRUVOTTIUR MILCH CATTLE MARKET

Madras, Friday the 17th November 1939.

Arrivals of cows and buffaloes are on the increase and the quality of stock has improved. There is no brisk business in the market due to continuous rainy weather and the demand for buffaloes is particularly poor which has resulted in a slight fall in their prices.

The stock movements during the week ending 17th November 1939 were as follows :—

	Stock at Commencement.	Arrivals during the week.	Sale during the week.	Balance.
Cows-Ongole	70	115	70	115
Buffaloes-country	110	114	60	164
Buffaloes-Delhi	3	...	...	3

Prices.

Age.	Milk yield.	Prices ranging From	To
		Rs.	Rs.
Cows-Ongole			
1st and 2nd calving	2—3 Madras Measures	70	90
	3—4 " "	90	120
3rd and 4th calving	2—3 " "	60	70
	3—4 " "	70	110
Buffaloes-country.			
1st and 2nd calving	2—3 " "	50	70
	3—4 " "	70	100
3rd and 4th calving	2—3 " "	50	55
	3—4 " "	55	80
Others.			
Buffaloes-Delhi		120	150
Cows-cross-bred		120	180

Market Report No. 21.

Madras, Friday the 24th November 1939.

Arrivals of cows and buffaloes are very low during the week and the stocks are poor. There is a brisk demand for country buffaloes and sales are on the increase. The prices of buffaloes have increased while a slight fall is noticed in the prices of cows.

The stock movements during the week were as follows :—

	Stock at Commencement.	Arrival during the week.	Sales during the week.	Balance.
Cows-Ongole	115	55	76	94
Buffaloes-country	164	61	114	111
Buffaloes-Delhi	3	...	...	3

Prices.

Age.	Milk yield.	Prices ranging From	To
		Rs.	Rs.
Cows-Ongole.			
1st and 2nd calving	2—3 Madras Measures.	70	90
	3-4 ,, ,,	90	110
3rd and 4th calving	2—3 ,, ,,	60	70
	3—4 ,, ,,	70	100
Buffaloes-country.			
1st and 2nd calving	2—3 ,, ,,	50	70
	3--4 ,, ,,	70	100
3rd and 4th calving	2—3 ,, ,,	50	60
	3--4 ,, ,,	60	85
Others.			
Buffaloes-Delhi.		120	150
Cows-cross-bred.		120	180

Market Report No. 22.

Madras, Friday the 1st December 1939.

With the advent of clear weather, arrivals of cows and buffaloes from the Ongole tract have increased. The demand for milch cattle has not increased owing to continued fodder scarcity. Prices are steady.

The stock movements during the week were as follows :—

	Stock at Commencement.	Arrivals during the week.	Sale during the week.	Balance.
Cows-Ongole	94	103	97	100
Buffaloes-country	111	105	96	120

Prices.

Age.	Milk yield.	Price ranging From	To
		Rs.	Rs.
Cows-Ongole.			
1st and 2nd calving	2—3 Madras Measures.	70	90
	3—4 ,, ,,	90	110
3rd and 4th calving	2—3 ,, ,,	60	79
	3—4 ,, ,,	70	100
Buffaloes-country.			
1st and 2nd calving	2—3 ,, ,,	50	70
	3—4 ,, ,,	70	100
3rd and 4th calving	2—3 ,, ,,	50	60
	3--4 ,, ,,	60	85
Others.			
Cows-cross-bred.		120	180

Market Report No. 23.

Madras, Friday the 8th December 1939.

The arrivals of cows and buffaloes are steadily increasing and the quality of stock has improved. The demand is moderate and prices are steady.

The stock movements during the week were as follows :—

	Stock at commencement.	Arivals during the week.	Sales during the week.	Balance.
Cows—Ongole	100	163	123	140
Buffaloes—country	120	175	135	160

Prices :

Age.	Milk yield.	Prices ranging From	To
Cows—Ongole		Rs.	Rs.
1st and 2nd calving	2—3 Madras Measures	70	90
	3—4 „ „	90	110
3rd and 4th calving	2—3 „ „	60	70
	3—4 „ „	70	100
Buffaloes—country			
1st and 2nd calving	2—3 „ „	50	70
	3—4 „ „	70	100
3rd and 4th calving	2—3 „ „	50	60
	3—4 „ „	60	80
Others			
Cows—cross-bred		120	180

(1 Madras measure of milk = 4 lbs.)

Crop & Trade Reports.

Statistics—Crop—Sugarcane 1939—Intermediate condition report. The condition of the sugarcane crop is generally satisfactory outside South Arcot where the crop is reported to have been affected slightly by stem-borer in parts. The yield is expected to be normal in all districts outside the Circars, South Arcot, North Arcot and Tanjore where it is estimated to be slightly below normal.

The wholesale price of jaggery per imperial maund of 82 2/7 (equivalent to 3,200 tolas) as reported from important markets on 4th December 1939 was Rs. 9—14—0 in Adoni, Rs. 9—2—0 in Vizagapatam, Rs. 7—8—0 in Cuddalore, Rs. 7—7—0 in Salem, Rs. 7—4—0 in Vellore, Rs. 7—3—0 in Rajahmundry, Rs. 7—1—0 in Vizianagaram, Rs. 7—0—0 in Bellary, Rs. 6—15—0 in Erode, Rs. 6—14—0 in Chittoor, Rs. 6—9—0 in Cocanada, Rs. 6—7—0 in Trichinopoly, Rs. 5—11—0 in Mangalore and 5—4—0 in Coimbatore. When compared with the prices published in the last report i. e., those which prevailed on 6th November 1939, these prices reveal a rise of approximately 10 per cent in Bellary, 8 per cent. in Vizagapatam and Coimbatore, 7 per cent in Vizianagaram and 6 per cent. in Adoni and Erode and a fall of approximately 13 per cent. in Chittoor, 11 per cent. in Cocanada, 10 per cent. in Rajahmundry, 7 per cent. in Cuddalore and 3 per cent in Mangalore, the prices remaining stationary in Vellore, Salem and Trichinopoly. *(From the Director of Industries, Madras).*

Cotton Raw, in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February to 22nd December 1939 amounted to 476,116 bales of 400 lb. lint as against an estimate of 388,900 bales of the total crop of 1938—39. The receipts in the corresponding period of the previous year were 521,110 bales. 410,440 bales mainly of pressed cotton were received at spinning mills and 181,867 bales were exported by sea while 142,580 bales were imported by sea mainly from Karachi and Bombay. *(From Director of Agriculture, Madras).*

College News and Notes.

Students' Corner. Students' Club – *The Hostel Tatler*:— The second number of the *Hostel Tatler* for the year, was published during this month. This is the first time that two issues are published in the same year and the students are to

be heartily congratulated on their effort in this direction. The Editorial board of the Hostel Tatler deserves great praise for the collection and proper editing of the materials published.

Dr. (Mrs.) Muthulakshmi Reddy addressed the students on 26—11—39 with Mr. K. C. Ramakrishnan, M. A., Lecturer in Economics, University of Madras, in the chair.

A debate "That in the opinion of the house a composite cabinet of Government is better suited to India than a single political party Government" was held on 29—11—39 with student Rajashekara Chetty in the chair. Mr. M. Kanti Raj was the observer.

Travancore Curzon Memorial Lectures. Under the auspices of the Madras University, Mr. K. C. Ramakrishnan, M. A., Lecturer in Economics, University of Madras, delivered a course of three lectures on 24th, 25th and 27th November 1939 on "Factors in Agricultural Development". The Lectures were greatly appreciated and a large number of students and officers attended the meetings.

Association of Economic Biologists. A meeting of the above association was held on 11th December in the Freeman building with Mr. M. C. Cherian, President of the Association in the chair. Two papers were read and discussed. The first paper was on "Some mutation in Rice" by C. R. Srinivasa Ayyangar and N. Parthasarathy. The second paper was on "Studies on soil moisture as affected by the frequency and method of irrigation in Cambodia cotton" by V. Ramanatha Ayyar and N. C. Thirumalachari.

Farewell to Mr. M. Kanti Raj. Mr. M. Kanti Raj, M. A., B. Sc., Junior Lecturer in Agriculture and Asst. Superintendent, Central Farm, was entertained at a farewell party on 9—12—39 by the students of the College, on the eve of his transfer as Assistant Director of Agriculture to St. Thomas Mount, Madras.

We are glad to announce that Mr. N. G. Charly who was till recently Research Engineer in this Department has been awarded the Gold Medal by the Imperial Council of Agricultural Research, for his improvements in the circular water lift. This is the second time an officer of this Department receives such an honour, the first being Mr. K. T. Thangavelu, who was offered the silver medal for his designing a turmeric polisher.

Visitors. Mr. H. M. Hood, adviser to His Excellency the Governor of Madras visited the Agricultural college and Research Institute on 21—12—39.

Mr. P. H. Rama Reddy, Director of Agriculture, Madras, stayed in the Estate from 20th to 22nd December.

Indian Central cotton committee. At the invitation of the Government of Madras the winter session of the Indian Central Cotton Committee will be held at the Agricultural College and Research Institute between the 15th and 20th of January 1940. Elaborate arrangements are being made by the reception committee for the reception to be accorded to the members of the committee.

Hindi Class. Hindi night classes have been started in the estate which are attended by over 25 officers of the Department. Great enthusiasm exists among the Hindi adherents, to master the language.

Weather Review—NOVEMBER 1939.

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	0·3	-3·7	31·0
	Calingapatam	0·7	-3·2	28·9
	Vizagapatam	3·5	-0·2	32·6
	Anakapalli*	3·9	-0·1	39·6
	Samalkota*			
	Maruteru*	8·6	+5·3	50·5
	Cocanada	7·7	+2·3	59·7
	Masulipatam	6·3	+0·6	47·7
	Guntur*	1·2	-2·0	34·6
Ceded Dists.	Kurnool	3·6	+2·4	20·0
	Nandyal*	0·0	0·0	0·0
	Hagari*	0·4	-1·0	21·3
	Siruguppa*	0·1	-1·4	21·3
	Bellary	1·6	-0·6	18·5
	Anantapur	1·2	-1·6	28·8
	Rentachintala	2·9		28·2
	Cuddapah	3·8	+0·2	26·5
	Anantharajupet*	10·8	+2·0	32·3
Carnatic	Nellore	12·3	+1·0	37·0
	Madras	13·0	-1·3	32·8
	Palur*	20·4	+8·0	53·4
	Tindivanam*	12·4	+2·0	40·3
	Cuddalore	21·0	+5·9	66·5
Central	Vellore	10·6	+3·7	39·9
	Salem	4·4	+0·6	47·9
	Coimbatore	4·0	+0·4	25·0
	Coimbatore A. C. & R. I.*	4·8	Nil	26·7
	Trichinopoly	18·0	+12·5	51·1

Division	Station	Actual for month	Departure from normal @	Total since January 1st
South	Negapatam	25·2	+7·5	55·3
	Aduthurai*			
	Madura	5·4	+0·5	36·2
	Pamban	16·5	+4·5	26·8
	Koilpatti*			
	Palamkottah	7·7	+0·3	17·5
West Coast	Trivandrum	18·2	+11·6	71·1
	Cochin	10·0	+3·5	133·7
	Calicut	6·1	+0·8	115·3
	Pattambi*	8·4	+4·7	97·1
	Taliparamba*			
	Kasargode*	3·8	-0·1	113·8
	Nileshwar*	5·7	+2·5	121·3
	Mangalore	3·9	+0·8	116·3
Mysore and Coorg	Chitaldrug	5·9	+3·6	34·1
	Bangalore	2·8	-0·1	35·2
	Mysore	2·7	+0·1	30·2
	Mercara	5·6	+2·3	104·7
Hills	Kodaikanal	24·5	+16·3	69·6
	Coonoor			
	Ootacamund*	20·4	+14·3	67·6
	Nanjanad*	9·1	+5·2	52·01

*Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1937 published in the Fort St. George Gazette.

Weather was unsettled in the Bay off the South Madras Coast early in the month when a shallow depression formed by the 7th, but became unimportant by the 9th. Unsettled conditions appeared in the Andaman sea on the 8th and moving out westwards on the 10th became unimportant by the 13th. A deep depression appeared in the southwest of the Bay on the 15th, and developing rapidly into a cyclonic storm of great intensity crossed the coast near Negapatam in the early hours of the morning of the 16th, but weakened equally rapidly but persisted as a trough of low pressure over south east Madras and extended to the North Madras Coast till the 21st when it became unimportant. Thereafter weather over the Presidency was generally dry.

Another depression formed in the Central Bay of Bengal on the 25th which however failed to affect weather in the Presidency.

During the passage of the depression in the Bay from the 15th till it disappeared, rainfall was locally very heavy in South East Madras and heavy in parts,

of the South Circar Coast. Rainfall was in excess in the southern districts Carnatic, parts of Circars, Travancore and the Hills.

Chief falls of rain were :

Trichinopoly 11·7″.
Usailipatty 13·8″.
Keeranur (Pudukottah) 11·3″.
Pudukottah 10·7″.
Ootacamund 8·1″.
Ernakulam 8·2″. All between 16th and 17th.

Weather Report for the Research Institute Observatory.

Report No. 11/39.

Absolute maximum in shade.	...	86·3°F.
Absolute minimum in shade.	...	63·5°F.
Mean maximum in shade.	...	83·1°F.
Departure from normal	...	-1·4°F.
Mean minimum in shade	...	68·9°F.
Departure from normal	...	+0·4°F.
Total rainfall for the month	...	4·81″
Departure from normal	...	Nil.
Heaviest fall in 24 hours	...	2·24″ on 16th.
Number of rainy days	...	6
Mean daily wind velocity	...	0·8 mile per hour.
Departure from normal	...	-1·4 m. p. h.
Mean humidity at 8 hours	...	84·6%
Departure from normal	...	+4·0%

Summary. The rainfall of 4·81 inches during the month was just normal 3·52 inches of this was received during the 3rd week of the month. The heaviest fall of 2·24″ was on the 16th. Skies were moderately to heavily clouded and the humidity was in excess. The mean maximum temperature was below normal. The mean minimum temperature was very slightly above normal and the mean daily wind velocity was below normal.

Departmental Notifications.

Gazettee Notifications.

Transfers.

Name of Officers.	From	To
Sri. M. Kanti Raj Naidu,	Offg. Junior L. A., and Supdt. Central Farm, Coimbatore.	Asst., D. A., St. Thomas Mount.
" A. Ramaswami Ayyar,	Offg. Asst. D. A., St. Thomas Mount, Madras.	Offg. Asst., D. A., Tiruppattur.
" V. T. Subbiah Mudaliar,	Offg. Asst., D. A., Tiruppattur.	Offg. Asst., D. A., Pattukottai.
Nawabzada Saddat-ul-lah Khan Esq.,	D. D. A., (on leave.)	D. D. A., Trichinopoly.
Sri. T. Murari	Supd. Live Stock Research Station, Hosur.	A. D. A. Pattukottai.

Subordinate Services.

Transfers.

Name of Officers.	From	To
Sri. K. Achuthan Nambiar,	Asst. A. D., in Mycology, Tellicherry.	Asst., A. D. in Mycology, Coimbatore.
Janab A. Azimmudin Sahib,	A. D. (on leave.)	A. D., Kulitalai.
Sri. V. V. Rajagopalan,	A. D. on Special duty under the S. G. S., Nellikupam.	Offg. Asst. in Entomology, Coimbatore.
,, K. Venkataswami Naidu,	A. D., Palladam.	A. D., Rapur, Nellore.
,, J. V. V. Suryanarayana,	A. D., Rajampet.	A. D., Rayachoti.
,, K. C. Thomas,	F. M. Central Farm (on leave.)	A. D., Palladam.
,, S. Veeravarada Raju,	A. D., Madanapalle.	A. D., Sriperumbudur.
,, E. Kunhappa Nambiar,	Gazetted Asst, to the Principal, Coimbatore.	F. M., in charge of the Central Farm.
,, A. Gopalan Nair,	Agricultural Upper Subordinate (on leave.)	F. M., Central Farm, Coimbatore.

Leave.

Name of Officers.	Period of leave.
Janab K. Soopi Haji Sahib, Offg. F. M., Sim's Park, Coonoor.	L. A. P. for 2 months from 4—1—1940.
Sri. K. Sapthariahi, A. R. S., Aduthurai.	L. a. p. for 1 month from 3—1—40.
,, U. S. Aiyaswami Ayyar, A. D., (on leave.)	Extension of l. a. p. on m. c. for 3 months in continuation of leave already granted.
,, M. Subba Reddi, A. D., Rayachoti.	Extension of l. a. p. on m. c. for 2 months from 8—11—39.
,, K. Govindan Nambiar, A. D., Choyyar.	L. a. p. on m. c. for 4 months from 22—11—39.
,, A. P. Balakrishnan Nair, A. D., Omalur.	Extension of l. a. p. on m. c. for 2 months from 21—11—39.
,, V. N. Subannacharya, A. D., IInd Circle.	L. a. p. for 3 months from the date of relief.
,, E. Kunhappa Nambiar, F. M., Central Farm, Coimbatore.	L. a. p. for 4 months from 3—1—1940.

Kerala Soap Institute, Calicut

UNDERTAKES THE ANALYSIS OF OIL SEEDS,

OILS, SOAPS AND SUCH PRODUCTS

FEES MODERATE

ENQUIRIES SOLICITED